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Student Employment and Study Effort for Engineering Students

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INTRODUCTION

The aim of this paper is to examine which factors effect student employment and study effort in a setting where engineering students are financially supported, such that their education is free of cost and that they receive financial support for living costs while studying. In addition, we wish to answer if the full-time student is under demise in these settings as opposed to settings without financial support [1, 2]. The research consisted of a web-based survey amongst all students at the Technical University of Denmark (DTU). The students in this survey had fewer employment hours and studied more than those in studies from e.g. UK and US [3, 4, 5]. A similar trend was seen in a study from Norway [6]. Government financial support seems to limit the amount of hours spent on paid work but not the percentage of students who take on paid work. Thus, full-time studies with benefits of increased capabilities and experience gained through employment could be aided by proper policies. Additionally, one of the highest impacts on study activity was the perceived study environment. As the engineering students have four hours per week of interaction with an instructor for each five ECTS, it is to be expected that the students generally spend a majority of their studying hours at the university. This study is to our knowledge the first to study student employment and study effort for Danish engineering students.

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1. BACKGROUND

In the last decade, there has been an increased amount of university students who take on paid work; either part-time or full-time [1, 4, 5, 7, 8]. The reported percentages of part-time employed students range from 54% to 81%. Main motivations for students to take on part-time employments while studying have been described mainly as economic motivations, such as meeting the costs of a university education or attempts to avoid an accumulation of debt while in university [3, 9]. Such economic factors should be understood in the context of the students' lifestyle needs [2]. However, recent research shows evidence that it is not only economic issues that drive students to take on part-time employment; other drivers such as "enhancing employability and transferable skills..." [3, 9] have also been identified. A large Australian study showed that students with part time employment during their studies receive larger salaries after graduating than those without, and also that the salaries increased with the number of hours of part time employment [10]. Thus, long-term economic factors could also be very prominent for students to take on part time employment.

Several scholars point to evidence in research that proves part time employment to be negatively associated with results in university [1, 8]. However, other scholars have evidence showing otherwise, where at "modest levels (say below 15 hours per week) work may actually enhance learning and academic success, and increase ones organization skills and employability [11, 12, 13]." [7]. Such a relation was also seen in a Norwegian study [6], where students with a job had slightly but significantly better grades than students without a job, and where the average number of working hours per week for the Norwegian students was 9-11, and the average number of study hours per week was 27-34. The Australian study [15] found similar better average academic performances for students working 1-10 hours per week, whereas this was not the case for students working more than 10 hours per week. However, these results did not hold true for students with the lowest and the highest grades.

Furthermore, it has been pointed out that we may be seeing the "demise of the full-time undergraduate student, as the number of students in part-time employment and the length of their working hours increase [14]." [15]. This would have serious consequences in the Danish context, as students receive financial support from the Danish government because they are full-time students, and thus if we are seeing the demise of the full-time students in this context the Danish government might have to re-evaluate the funds given to students enrolled in full-time education.

Research points in different directions concerning the consequences of taking on paid employment while in university. It is an individual matter, which is complicated further by the different nature of policy makers in nation-states globally, even as grading standards are becoming increasingly adaptable across nations and systems. This research paper analyses a data set from DTU, to research the effect of part-time employment and leisure activities on study habits. This is an interesting and different subject compared to other studies within this area of research because of the contextual conditions in Denmark presented in the next section.

1.1. Danish context

Higher education institutions and students in Denmark are unique in two aspects. Firstly, universities are free of cost for Danish students as long as they fulfill the requirements stated by the Danish government [16]. Furthermore, Danish students are eligible to receive financial support from the Danish government. The financial support from the Danish government is in place in order for students not to engage in too much activity outside of university and to be able to fulfill the full-time study requirements. Full-time studies should thus correspond to at least a full working

week, i.e. 37 hours per week including class and study time. Although, the guidelines from DTU say it should be 45 hours per week. It is important to note that the Danish government does not simply give free education and monthly fees to students; there is an expectation that these students will pay these fees back to the government through taxation by working in Denmark after they have graduated. As for the international students, the ones coming from within the EU do not have to pay tuition at Danish Universities. However, they do not receive the monthly study support, unless they as well fulfill certain additional requirements than those for the Danish students (www.su.dk). In the Norwegian comparison the students also get support from the Government (www.lanekassen.no), but still financial reasons are the biggest motivators for taking on employment [17].

1.2. Engineering context

The Technical University of Denmark provides 4 hours per week with one or more instructor(s) for each 5 ECTS course during 13 weeks. Compared to other Danish Universities, the expected number of hours spent at the University is higher.

2. MATERIALS AND METHODS

A survey of the student environment was performed in the fall 2012 at DTU. All students were asked to fill out a questionnaire with questions related to their studies. Out of approximately 7800 students, 2915 completed the questionnaire resulting in a response rate of 37%. The survey included: Age, gender, education type, Nationality, student activity, student effort, student employment, leisure activity, voluntary work, and student satisfaction.

There are 6 types of educations at DTU: Bachelor of Science (BSc), Master of Science (MSc), Diploma engineer (Diploma) which is at Bachelor level but takes 6 months longer and includes practical training, a part-time MSc (Partly MSc) where students generally work and take their MSc as a part-time study, and Open University (Open Uni) where students take one or more individual course(s) at DTU. As the number of responses from students of other nationalities than Danish was relatively low (412), Nationality was grouped into two categories: Danish/Other - this also makes sense in relation to determining the effects of the government support provided by the Danish government.

The students' course activity (Activity) was divided into 'less than the norm', 'the norm', or 'more than the norm'. The norm is 30 ECTS (European Credits) per semester; split into a long semester of 13 weeks with a 25 ECTS load, and a 3-week course with a load of 5 ECTS. The students were asked during the 13-weeks period. Furthermore, the students were asked about their study effort in hours per week, their paid employment, their voluntary work, and their leisure activities also in hours per week. The students' gender, age, and nationality were also collected. Finally, the student's were asked to rate the agreement on the following statement: "I generally feel comfortable and thrive at the University" on a discrete scale from 1 to 7, where 1 corresponds to strongly disagreeing and 7 corresponds to strongly agreeing with the statement. A summary of the data is seen in *Table 1*.

Table 1: Summary of the data. The student study effort in hours per week, the student's hours of industrial employment per week, the student's gender, the student's age, the student's activity measured in number of ECTS for that semester (less than, equal to or more than the norm of 25 ECTS per semester), the student's Nationality, the student's education, the amount of leisure activities per week, the amount of voluntary work per week, and the student satisfaction (study environment).

Effort						
0-5 h 190	6-10 h 638	11-15 h 704	16-20 h 560	21-25 h 321	26-30 h 173	>30 h 219
Employment						
0-5 h 1606	6-10 h 597	11-15 h 360	16-20 h 119	21-25 h 41	26-30 h 14	>30 h 41
Gender						
Female 976			Male 1939			
Age						
18-19 y 226		20-21 y 796		22-24 y 1061		>24 y 832
Activity						
<Norm 689		=Norm 1765			>Norm 367	
Nationality						
Danish 2503			Other 412			
Education						
BSc 1306	Entrance 30	Diploma 621	MSc 936	Partly MSc 10	Open Uni 12	
Leisure						
0-2 h 784		3-5 h 1148		6-10 h 616		>10 h 230
Voluntary						
0-2 h 2335		3-5 h 290		6-10 h 95		>10 h 58
Environment						
1 16	2 70	3 130	4 285	5 873	6 1280	7 10

Since the factors that influence employment and study effort, and the collected data are ordinal of nature (e.g. effort, employment, age and activity), we chose to use a cumulative link model (CLM) for ordinal logistic regression. The explanatory ordinal variables were coded by orthogonal polynomials to increase the interpretability and decrease the complexity of the model. For the polynomials, the estimated coefficients can be interpreted in the following way: for one unit increase in the variable (one level), the log odds of a unit increase in the response (one level) increases/decreases by the estimated coefficient. We fit the cumulative link model with the ordinal package in R [18]. Out of 2915 observations, 281 observations were removed because of missing values (9.6% of the observations).

3. RESULTS

42% of the students are employed more than 5 hours per week, and 45% of the students have a study effort (outside of the classroom) of more than 15 hours per

week. For a student attending the normed courses, the time spent in classes will amount to 20 hours per week. This means that approximately 45% of the students in the survey have a full time study (36-40 hours or more). The normed study effort guideline made by the university is however 45 hours per week, but only 14% of the students study more than this requirement. The following sections summarize the results for the CLM model for the two responses: Study effort, and study activity.

1.1. Study Effort

First, we modeled the study effort as a function of all the other variables. The analysis showed that an industrial employment had a significant negative linear effect on the study effort ($p=7.4e-6$). Students that work more are more likely to study less (Odds ratio=0.25). Age had a positive and significant linear as well as quadratic effect on student effort ($p=3.3e-5$, $p=0.0024$). Thus, older students spent more time on their studies (Linear odds ratio = 1.6 and quadratic odds ratios=0.9). The student activity, measured in the number of ECTS points taken in that specific semester, showed a positive and significant linear effect on the student effort ($p=2.6e-11$). Students that take on more courses also study more (Odds ratio=1.8). Students with other nationalities had a significantly higher study effort than Danish students ($p=8.1e-12$). The odds of a student of another nationality to study five hours more than a Danish student were 2.2. Students studying for Diploma Engineers had a significantly lower study effort than the BSc students ($p=6.3e-5$, odds ratio=0.68), whereas students studying a MSc had a significantly higher study effort than BSc students ($p=0.0093$, odds ratio=1.3). Master students tended to study more than Bachelor students. The student's leisure activities had a significant negative linear effect on the study effort ($p=0.028$, odds ratio=0.8). And the perceived study environment had a significant positive cubic effect on study effort ($p=0.014$, odds ratio=2.2). The significances of these two effects are rather small in particular taking into account the high number of covariates. There was no significant effect from gender on study effort ($p=0.65$). Voluntary work likewise showed no significant effect on study effort ($p=0.61$).

1.2. Study Activity

Additionally, we made an analysis of the study activity and the influence of the factors: employment, age, gender, nationality, leisure activity, voluntary work, study environment and education on this. The analysis showed that industrial employment had a negative and significant linear effect on the study activity ($p=0.00031$, odds ratio=0.3). Students who take on more paid work are more likely to take fewer classes per semester. Age had a significant negative linear effect on the study activity as well as a significant positive cubic effect ($p=2.6e-6$, $p=0.0056$) with odds ratios (linear=0.54, cubic=1.1). The study activity thus seemed to drop for students between 20-21 years and then increase again for students above 22 years. Students of other nationalities had a significantly higher study activity when compared to the Danish students ($p=5.6e-9$, odds ratio=2.2). MSc students, Part time MSc students and open MSc students all had significantly lower student activities than the BSc students ($p=7.9e-5$, $p=0.07$, $p=0.0094$) with odds ratios (0.61, 0.12, and 0.06, respectively), whereas there was no significant difference in study activity between Diploma and BSc students ($p=0.86$). Open university students had a much lower activity than the BSc students (odds ratio=0.06), which is not surprising, as they in general tend to have a full time employment occupation. The amount of voluntary work had a significant negative effect on the study activity; both linear and quadratic ($p=7.9e-6$, $p=0.00016$) with odds ratios of (0.4 and 0.48, respectively). The perceived study environment had a positive significant linear effect on the study activity

($p=0.00078$). The odds of a student, who rated the study environment one higher than the lowest level, to take on more courses were 5.3, which is a relatively high effect. The student's leisure activities had no effect on the student activity level. There was no significant effect from gender on study activity at a 5% level of significance (0.087).

4. DISCUSSION & CONCLUSION

The discussion will focus on differentiating the Danish context from the extensive existing previous research, a discussion of the main findings will follow with specific emphasis on the 'full-time' student [14, 15], and the role of the study environment in relation to study efforts.

Many scholars [4, 7, 8, 19] have pointed out that economic issues or worries of being indebted by attending university were the main motivations for students to take on part-time employment while studying. Others have pointed to the fact that other motivations are also in play such as employability and work experience [7]. Because of the financial support given by the Danish government, the argument could be made that most part-time employment taken on by Danish students is caused by reasons of resumé expansion rather than financial concerns. Furthermore, even if students feel as if they need extra money each month they might be able to employ themselves for shorter hours per week than students in other countries with no governmental support. Taking on a job for shorter hours each week may indeed prove to be beneficial for the student in three areas; finances, employability, and enhancement of learning and academic success [7]. It seems feasible to make these claims since the Danish government is taking on a large bulk of the expenses of both attending university but also living expenses while doing so.

Whether or not we are seeing a demise of the full-time student is up for discussion. However, it does not seem to be as severe in the case of DTU as in other studies [14, 15]. Of the students enrolled in 'full-time studies' (25 ECTS points), 47% spends 36 hours or more on their studies per week. This corresponds to full-time employment in the social context (37 hours per week). Also, 73% of students enrolled in full-time studies spend 31 hours or more on their studies per week. We would expect these numbers to go up during exam periods and during intensive project work periods. Funds given by the government to students studying full-time are thus somewhat justified in this context. Furthermore, the amount of work outside of higher education is smaller compared to studies in the US and UK, but similar to studies from Norway, as 92% of students' part-time work ranges from 0-15 hours per week. Previous studies reported that a moderate work-load (below 10-15 hours per week) could be beneficial for the student [6, 7, 11, 12, 13]. Interestingly, 58% of the students' part-time work ranges from only 0-5 hours per week, which is a significantly smaller amount than that observed in other studies, namely an average of between 11-14 hours per week [20]. The high percentage of students at DTU taking on a low to moderate level of employed work can be explained by the Danish government's policies of free education and monthly fees given to the students attending full-time education, this can thus also explain the assumptions on students' motivations for taking on employed work while studying. Providing evidence that the demise of the full-time student would be a myth in the Danish context, as a large percentage of students do indeed spend time on their studies corresponding to, or very close to the same amount of time required by an ordinary full-time employee in a Danish workplace. Our results show that industrial employment has a negative linear effect on study activity. However, because of the amount of the working hours, as explained above, it does not seem to effect student activity to the point where they are not spending enough (full-time) hours on their studies.

In the results of the data analysis, study environment proved to be important for whether students study the norm, less than the norm, or more than the norm. We did not come across any previous research in the area of study environment to rely on, thus we will draw our own conclusions in relation to this subject. The majority of students study the norm, and the impact of study environment is, in particular, high on study activity. Thus, study environment seems to be a key factor of motivation for students' study load, and something administrators in higher education should pay attention to. As student satisfaction in the study environment increases, so does their activity level and their effort. This gives us a hint that study environment perhaps is more important than other factors, such as how much time students spend on activities outside the educational environment. The students were asked to rate the statement, "I generally feel comfortable and thrive at the University". Thus, the comfort and thriving of students could just as well as the physical environment, be mental and social factors such as how they are treated by other people, general support from teachers and administrators, social events and the like. It is important to note, that administrators alone cannot control the study environment for students; social events and the openness of other students is something that can be facilitated by administration through classroom experiences etc., but in the end it is also up to students themselves to take on this responsibility.

There are certain limitations to this study, which needs to be mentioned. The study had a non-respondent rate of 63% and thus may not generalize to the non-respondents. The study only considers engineering students and only students at one university in Denmark. This makes generalizations impossible but rather lays a foundation for comparisons and inspiration to mutually learn from the Danish engineering context as well as the comparative contexts.

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